2514

50539-Z

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Shinichiro Tsuda et al.

Serial No.: 08/627,,580

Filed : April 4, 1996

For : ANTENNA COUPLING APPARATUS, EXTERNAL-ANTENNA CONNECTING APPARATUS, AND ONBOARD EXTERNAL-ANTENNA CONNECTING APPARATUS

Group : 2514

Examiner : H. Le

EXPRESS MAIL LABEL NO.: EE118168287US

February 18, 1998
1185 Avenue of the Americas
New York, NY 10036
(212) 278-0400

REQUEST FOR DIVISIONAL APPLICATION
UNDER 37 CFR 1.53(b)

Assistant Commissioner for Patents
Box CPA
Washington, D.C. 20231

Sir:

This is a request for filing a Divisional application under 37 CFR 1.53(b) of pending prior application Serial No. 08/627,580 filed April 4, 1996.

1. [x] Enclosed is a copy of the prior application as originally filed including a copy of the signed Declaration filed September 5, 1996 and a copy of the drawings.

2. [x] The prior application is assigned to Sony Corporation and the Assignment was recorded on September 5, 1996 at Reel 8140, Frame 0573.

3. [x] Priority of Application(s) No.(s) P07-108216 filed on April 8, 1995 respectively, in Japan is claimed under 35 USC 119.

[x] The certified copy in support of the claim of priority has been filed in the Prior Application Serial No. 08/627,580 and acknowledgment thereof is requested.

4. [ ] This is an application of a small entity under 37 CFR 1.9(f), and the amounts shown below in parentheses apply.

b. [x] The filing fee is calculated below:

Claims Appearing in the Prior Application, Less Any Claims Canceled By Amendment Below

	Number Filed		Number Extra	Fee
Basic Fee				$790 ($395)
Total claims.....	13	- 20 =		$22 ($11)
Independent claims...	5	- 3 = 2x		$82 ($41) $164

Total Filing Fee.....$ 954.00

5. [x] The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Account No. 03-3125. A duplicate copy of this sheet is enclosed.

6. [x] A check in the amount of $ 954.00 is enclosed.

7. [x] Cancel claims 6 and 11-15.

8. [x] Amend the specification by inserting before the first line the sentence: --This is a division of prior application Serial No. 08/627,580 filed April 4, 1996.--

9. [x] Incorporation by Reference: The entire disclosure of the prior application identified above is considered as being a part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

10. [x] The power of attorney in the prior application is to Jay H. Maioli, Reg. No. 27,213, Cooper & Dunham, 1185 Avenue of the Americas, New York, N.Y. 10036.

a. [x] The power appears in the prior application.

b. [x] Address all future communications to: Jay H. Maioli, Cooper & Dunham, 1185 Avenue of the Americas, New York, NY 10036.

11. [x] A Preliminary Amendment is enclosed.

Jay H. Maioli
Reg. No. 27,213

(212) 278-0400

JHM:dma

50539-Z

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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For : ANTENNA COUPLING APPARATUS, EXTERNAL-ANTENNA CONNECTING APPARATUS, AND ONBOARD EXTERNAL-ANTENNA CONNECTING APPARATUS

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1185 Avenue of the Americas
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PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

This application is a divisional of U.S. Patent Application No. 08/627,580 filed April 4, 1996. Prior to the initial examination of the above-identified application, Applicants respectfully request that the application be amended as follows.

IN THE SPECIFICATION

Page 1, line 10, delete "together".

Page 3, line 13, delete ", having the electromagnetic coupling element 2,";

line 15, delete "installed to the portable radio terminal 5,";

line 25, delete "installed".

Page 4, line 6, change "an" to --the--;

line 11, change "its" to --an--;

line 19, after "of" insert --a--.

Page 5, line 4, delete "high" second occurrence;

line 9, change "non-contact" to --out of contact--;

line 10, after "and" insert --that--;

line 12, change "with" to --which has--;

line 13, change "non-contact" to --out of contact--;

line 15, after "and" insert --that--;

line 23, change "non-contact" to --out of contact--.

Page 6, line 6, change "non-contact" to --out of contact--;

line 13, change "non-contact" to --out of contact--;

line 17, change "non-contact" to --out of contact--.

Page 7, line 5, change "non-contact to --out of contact--;

line 11, after "and" second occurrence, insert --allow--.

Page 9, line 24, after "antenna 6," insert --which is--.

Page 10, line 7, after "4" insert --physically--;

line 8, after "in" second occurrence, insert --electrical--;

line 14, change "are" to --may be--;

same, line, change "positions" to --position--;

line 19, change "in" to --, both of which have a--;

line 21, after "coupled" insert --to the external antenna, not shown--.

Page 1, line 12, change "antenna 6" to --coupling element 2--;

line 13, change "antenna" to --coupling element 2--;

line 14, after "element 21" to --back--.

Page 12, line 22, change "one" to --antenna couplers--.

Page 13, line 13, change "and" to --with,--;

line 16, after "element 21" insert --that are both--;

same line, change "that are" to --, which is--.

Page 16, line 3, after "and" insert --to--;

line 9, after "antenna 6," insert --which is--;

line 18, after "held" insert --in the hand of the user--;

line 21, after "circuit" insert --32--.

Page 17, line 3, delete "from the electro-magnetic coupling circuit 32";

line 4, after "cable 33" insert --and the electro-magnetic coupling circuit 32--.

Page 18, line 16, after "stably" insert --to--.

Page 23, line 7, after "terminal" insert --array--;

line 9, after "terminal" insert --array--;

line 11, after "terminal" insert --array--;

line 15, after "terminal" insert --array--;

line 17, after "terminal" insert --array--;

line 20, after "terminal" both occurrences, insert --array--.

Page 24, line 2, after "but" insert --also--;

line 9, change "non-contact" to --not in contact--;

line 13, change "non-contact" to --not in contact--;

line 24, change "non-contact" to --not in contact--.

Page 30, line 6, delete ". An antenna coupling apparatus";

line 7, change "non-contact" to --not in contact;

line 9, change "non-contact" to --not in contact--;

line 19, change "non-contact" to --not in contact--.

IN THE CLAIMS

Please cancel claims 6 and 11-15, please add new claims 16-19, and please amend claims 1-5 and 7-10 by rewriting same to read as follows.

--1. (Amended) An antenna coupling apparatus comprising:

a first antenna [installed] connected to a portable radio terminal, said first antenna being elongated in an axial direction;

a second antenna [differing] separated from said first antenna [together];

an electromagnetic coupling element consisting of a conductor that [is] electromagnetically couples said first and said second antennas together arranged adjacent to said first antenna at a first location along the axial direction of said first antenna; [and]

a ground conductor element arranged proximate said first antenna; and

a reflective ground element arranged adjacent to said first antenna and disposed a predetermined distance from said electromagnetic coupling element along said first antenna in the axial direction for reflecting [the] power transmitted from or received by said first antenna toward said electromagnetic coupling element.

--2. (Amended) The antenna coupling apparatus according to claim 1, wherein said electromagnetic coupling element and said reflective ground [conductor] element are [open at the top like a letter of the

alphabet U, or are] in the form of a [ring or U shape having a width in the X direction] trough with a U-shaped cross section.

--3. (Amended) The antenna coupling apparatus according to claim 1, wherein said [first antenna and said second antenna are electromagnetically coupled together, using a plurality of said] electromagnetic coupling [elements and/or] element and said ground conductor [elements] element are each comprised of a plurality of electrically connected portions.

--4. (Amended) The antenna coupling apparatus according to claim 1, further comprising a matching circuit [that matches] for matching an impedance of said first antenna with said second antenna.

--5. (Amended) The antenna coupling apparatus according to claim 1, wherein said electromagnetic coupling [elements] element [and], said ground conductor [elements] element and said reflective ground element are disposed at [any plurality of positions, taken] predetermined locations taking into account [the] an impedance matching of said first antenna.

--7. (Amended) An external-antenna connecting apparatus for a portable radio terminal comprising:

an onboard antenna [installed] connected to [a] the portable radio terminal;

an external antenna coupled with said onboard antenna;

a body for [securing said] receiving the portable radio terminal [to said body] therein;

an electromagnetic coupling circuit disposed in said body[, which circuit] for electromagnetically [couples the] coupling said onboard antenna of [said] the portable radio terminal and said external antenna [together], said coupling circuit being [non-contact] out of contact with said portable radio terminal with respect to DC components[,] when [said] the portable radio terminal is [secured to] received in said body, said electromagnetic coupling circuit including:

a electromagnetic coupling element arranged proximate to said onboard antenna at a first location along an axis of said onboard antenna;

a ground conductive element arranged proximate to said onboard antenna for providing a ground plane; and

a reflective ground element electrically connected to said ground conductive element and arranged proximate to said onboard antenna at a second location along the axis of said onboard antenna a predetermined distance from said first location for reflecting radio frequency energy toward said electromagnetic coupling element.

--8. (Amended) The external-antenna connecting apparatus according to claim 7, wherein said

electromagnetic coupling circuit [is fitted with] includes a nonconducting cover.

--9. (Amended) The external-antenna connecting apparatus according to claim 7, wherein said electromagnetic coupling circuit has a U-shaped cross section [corresponding to an electromagnetic coupling element and a ground conductor element].

--10. (Amended) The external-antenna connecting apparatus according to claim 7, [said antenna connecting apparatus has] wherein said body and said electromagnetic coupling circuit form a case for said portable radio terminal, [and is] said case being shaped to cover [the] a part of the portable radio terminal which includes [the] said onboard antenna of [said] the portable radio terminal[,] and to hold the entire portable radio terminal when [fitted over the terminal to] inserted into the case.--

16. (New) The antenna coupling apparatus according to claim 1, wherein the electromagnetic coupling element and the ground coupling element are formed in a ring shape and disposed coaxially with said axial direction of said first antenna and wherein said ground conductive element is planar.

17. (New) An antenna coupling apparatus comprising:

an electromagnetic coupling element for receiving an electromagnetic signal, said coupling element having a shape which defines a receiving plane;

a ground plane conductor arranged proximate to the electromagnetic coupling element for establishing a ground plane;

a reflective ground element disposed in a predetermined relation to the electromagnetic coupling element and electrically connected with the ground plane conductor and formed of a shape which defines a reflecting plane said reflecting plane being substantially parallel to said receiving plane, for reflecting electromagnetic energy toward the electromagnetic coupling element.

18. (New) An antenna coupling apparatus for coupling an external antenna with a fixed antenna connected with a portable radio terminal, the apparatus comprising:

a body for receiving the portable radio terminal therein; and

an electromagnetic coupling having a trough-like shape with a U-shaped cross section elongated in an axial direction for receiving the fixed antenna when the portable terminal is disposed in said body, the coupling including:

an electromagnetic receiving element disposed at a first location along the axial direction of said trough-shaped coupling, electrically insulated from the

fixed antenna for receiving electromagnetic oscillating signals from the fixed antenna and having a U-shaped cross section being conformal with the cross section of the electromagnetic coupling;

a ground plane disposed proximate to the receiving element; and

a reflective ground element disposed at a second location a predetermined distance from the first location along the axial direction of said coupling, electrically insulated from the fixed antenna, having a U-shaped cross-section being conformal with the cross section of the electromagnetic coupling for reflecting electromagnetic energy transmitted by the fixed antenna toward the receiving element.

--19. (New) An onboard external-antenna connecting apparatus for a portable radio terminal comprising:

an onboard antenna installed on the portable radio terminal;

an external antenna connected to said onboard antenna;

an external power for supplying power to the portable radio terminal;

a body for securing said portable radio terminal upon installing the portable radio terminal into said body from above;

an electromagnetic coupling circuit disposed in said body for electromagnetically coupling said onboard

antenna of said portable radio terminal and said external antenna, said coupling circuit being out of contact with said portable radio terminal with respect to DC components when the portable radio terminal is secured in said body;

a connecting member arranged in said body for connecting said external power and the portable radio terminal together to supply power from said external power to the portable radio terminal;

a mounting member movably connected to said body and operating in conjunction with the installing of the portable radio terminal in said body and including a first connector for communication from said external apparatus; and

a second connector installed on the portable radio terminal communication with said external apparatus when connected with said first connector.--

REMARKS

Claims 1-5 and 7-10 remain in this application having been amended hereby. Claims 6 and 11-15 have been canceled without prejudice or disclaimer and claims 16-19 have been added hereby.

The discrepancy noted by the Examiner in the Preliminary Amendment at page 2, line 25 filed December 17, 1996 has been corrected in this Preliminary Amendment.

In the parent of this application claims 1, 4, 5, 7, 8, and 10 were rejected under 35 U.S.C. § 102(e) as being anticipated by Pottala et al.

The present invention is directed to an apparatus for coupling a portable radio terminal to an external antenna. Coupling between the radio terminal and the apparatus is improved over known systems by including a reflective element near the coupling element. This reflective element improves coupling, as shown by comparing curves a and b in Fig. 5.

The arrangement of the reflective element is shown, for example, in Fig. 4. The reflective element 21 is electrically connected with an element which forms a ground plane 4 and is disposed along the antenna 6 of the radio terminal a predetermined distance, S2, from the coupling element 2.

The coupling element 2 and reflective element 4 define two planes. These planes are substantially parallel to each other and are arranged along the axis of the antenna. It is this arrangement of the coupling and reflecting elements that creates improved coupling over known devices.

As shown in Fig. 9, and as taught at page 15 of the specification, the coupling element 2 and reflection element 21 may be formed with a U-shaped cross section to more easily accommodate the antenna of a portable radio terminal.

Claims 1-5 and 6-10 have been amended to more clearly recite the relation of the reflective element to

the coupling element. Newly added claims 16-18 also recite this feature.

Pottala et al. shows an entirely different apparatus for coupling an external antenna to the antenna of a portable telephone.

As shown in Figs 2 and 3, a coupling element 240 is disposed near an antenna and is surrounded by a cylindrical grounded element. The cylindrical ground element is completely closed around the antenna and keeps the energy emitted by the antenna "substantially contained" within the conductor. Col. 3, lines 24-28.

The apparatus of Pottala et al. is more cumbersome than the present invention because a closed conductive chamber must be formed around the antenna. Such an arrangement requires a complicated mechanical assembly that must be opened and closed each time the telephone is coupled to the apparatus.

The present invention, on the other hand, functions by merely arranging coupling and reflective elements at predetermined positions along the antenna. As shown in Fig. 9 of the present invention, the coupling and reflecting elements may be formed in a u-shaped trough so that the antenna is simply placed in the apparatus.

Because coupling devices, such as the one taught by the present invention, are often used by automobiles drivers, a simple mechanism for inserting and retrieving a portable telephone is critical to the functionality of the device. Drivers may need to insert

or remove the telephone while driving without looking at the coupling device. The added complexity of opening and closing the coupling chamber of Pottala et al. would diminish its effectiveness for this type of application, as compared to a coupling device taught by the present invention.

Pottala et al. fails to show or suggest a coupling mechanism in which a reflective element is arranged a predetermined distance along an antenna axis from a coupling element, as recited in the amended and newly added claims. For at least this reason Pottala et al. fails to show or suggest the present invention.

Accordingly, in light of the amendments made to the claims hereby, as well as the above remarks, it is respectfully submitted that an antenna coupling apparatus, as taught by the present invention, and as recited in the amended and newly added claims, is neither shown nor suggested by the reference cited in the parent to this application.

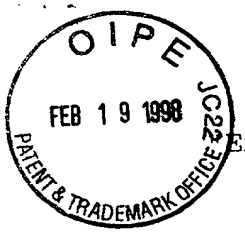
It is hoped that this Preliminary Amendment will facilitate an early examination of the application on its merits.

Respectfully submitted,

COOPER & DUNHAM LLP

Jay H. Maioli
Reg. No. 27,213

JHM:dmcd



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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Date of Deposit: February 19, 1998

I hereby certify that this Request For Divisional Application Under 37 CFR 1.53(b), Copy of Specification and claims, Copy of Drawings, Copy of Signed Declaration, and Preliminary Amendment are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and addressed to the Assistant Commissioner for Patents, Box CPA, Washington, D.C. 20231.

Trinidad Iscoa

Inventors : Shinichiro Tsuda et al.

Title : ANTENNA COUPLING APPARATUS, EXTERNAL-ANTENNA CONNECTING APPARATUS, AND ONBOARD EXTERNAL-ANTENNA CONNECTING APPARATUS

Serial No.: 08/627,580

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ANTENNA COUPLING APPARATUS, EXTERNAL-ANTENNA CONNECTING APPARATUS, AND ONBOARD EXTERNAL-ANTENNA CONNECTING APPARATUS

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The present invention relates to an antenna coupling apparatus, an external-antenna connecting apparatus, and an onboard external-antenna connecting apparatus, which are suitable for electromagnetically coupling an antenna installed to a portable radio terminal and an external antenna installed to an automobile together.

DESCRIPTION OF THE RELATED ART

An antenna coupling apparatus using electromagnetic coupling, called a coupler, has widely been used for onboard antenna kits to couple the antenna installed to a portable radio terminal, such as a portable phone, with an external antenna installed to an automobile.

Fig. 1 shows an example of the antenna coupling apparatus. An antenna coupling apparatus 1 comprises an electromagnetic coupling element 2 and a transmission cable 3. The electromagnetic coupling element 2 of the antenna coupling apparatus 1, which element is ring-shaped, is connected to the core of the transmission cable 3 (in some cases, the element is connected to a ground conductor 4 through a nonconducting member

as shown in Fig. 1). Inserting the antenna 6 fitted with a nonconducting cover and disposed on a portable radio terminal 5 into the ring-shaped electromagnetic coupling element 2 allows the power received from an external antenna to be transmitted through the electromagnetic coupling element 2 to the portable radio terminal 5 and the power transmitted by the portable radio terminal 5 to be transferred to the external antenna without contact with respect to DC components.

Fig. 2 shows an example of an external-antenna connecting apparatus connecting an external antenna and the antenna of a portable radio terminal together. The external-antenna connecting apparatus 10 comprises a curled cord 11 and a connector 12 that connect the external antenna and an external power supply (not shown). Connecting the connector 12 of the antenna connecting apparatus 10 to a connector terminal 14 in the lower part of a portable radio terminal 13 allows the terminal 13 to receive power from the external power supply and transmit a radio frequency (RF) signal to, or receive it from, the external antenna through the curled cord 11 and the connector 12.

As shown in Fig. 3, an external antenna connecting apparatus 15 comprises an electromagnetic coupling circuit 18, fitted with a nonconducting cover, and a transmission cable 19. The electromagnetic coupling circuit 18 is provided with a hole corresponding to the antenna 17 to install the antenna 17, fitted

with a nonconducting cover, of a portable radio terminal 16. For the external-antenna connecting apparatus 15, fitting the electromagnetic coupling circuit 18 over the antenna 17 in the direction indicated by an arrow allows the antenna 17 and the electromagnetic coupling circuit 18 to be electromagnetically coupled together and thus an RF signal to be transmitted to, or received from, the external antenna.

An antenna coupling apparatus incorporating an electromagnetic coupling element electrically connects a portable radio terminal and an external antenna together, using electromagnetic coupling.

It is difficult for the conventional antenna coupling apparatus 1, having the electromagnetic coupling element 2, of Fig. 1 to receive all the power emitted from the antenna 6 installed to the portable radio terminal 5, using only the electromagnetic coupling element 2, so that unnecessary power emissions occur. Thus the apparatus 1 poses a problem of heavy loss which occurs when power is transmitted.

In the external-antenna connecting apparatus 10 of Fig. 2, a cable for transmitting an RF signal from an antenna power supply (not shown) installed on the portable radio terminal to the connector terminal 14 must be installed in the portable radio terminal 13 to enable an RF signal to be transmitted to, or received from, the external antenna.

The cable installed, however, may cause the performance of

the portable radio terminal 13 to be deteriorated when the terminal 13 is used independently. What is worse, installing the cable inside the portable radio terminal may causes the portable radio terminal to be difficult to reduce in size.

The external-antenna connecting apparatus 15 in Fig. 3 has an disadvantage in that the electromagnetic coupling circuit 18 is not easy to fit over the antenna 17 of the portable radio terminal 16.

Poor adhesion between the electromagnetic coupling circuit 18 and the antenna 17 causes the circuit 18 to shift, resulting in its unstable coupling with the antenna 17.

Thus increasing adhesion between the electromagnetic coupling circuit 18 and the antenna 17 causes the portable radio terminal 16 to be more frequently used by a user, so that the antenna 17 is more often installed in, or removed from, the electromagnetic connecting circuit. Since the nonconducting covers for the antenna 17 and the electromagnetic coupling circuits 18 are overloaded due to friction, their durability may be lowered. If the antenna 17 is of threaded type, it may come off the body of the portable radio terminal 16 as the antenna connecting apparatus 15 is installed or removed.

SUMMARY OF THE INVENTION

In view of the foregoing, an object of the present invention

is to provide an antenna coupling apparatus, an external- antenna connecting apparatus, and an onboard external-antenna connecting apparatus which inhibits unnecessary power emissions, reduces transmission loss, and offers high durability and high ease of operation.

The foregoing object and other objects of the present invention have been achieved by the provision of an antenna coupling apparatus which is provided with an electromagnetic coupling element consisting of a conductor that is non-contact with a first antenna with respect to DC components and electromagnetically couples the first antenna and a second antenna together and with a ground conductor element consisting of a conductor that is non-contact with the first antenna with respect to DC components and in contact with a ground conductor with respect to DC components and reflects the power transmitted or received by the first antenna toward the electromagnetic coupling element.

For an external-antenna connecting apparatus according to the present invention, a body to which a portable radio terminal is secured by positioning the terminal from above, and an electromagnetic coupling circuit that electromagnetically couples the antenna of the portable radio terminal and an external antenna together, being non-contact with the portable radio terminal with respect to DC components, when the portable radio terminal is positioned in the body is disposed inside the body.

For an onboard external-antenna connecting apparatus according to the present invention, a body to which a portable radio terminal is secured by positioning the terminal from above, an electromagnetic coupling circuit that electromagnetically couples the antenna of the portable radio terminal and an external antenna together, being non-contact with the portable radio terminal with respect to DC components, when the portable radio terminal is positioned in the body is disposed inside the body, and a connecting member is provided which connects an external power supply with the portable radio terminal to feed power from the power supply to the terminal.

In an antenna coupling apparatus, an electromagnetic coupling element consisting of a conductor that is non-contact with a first antenna with respect to DC components and electromagnetically couples the first antenna and a second antenna together and a ground conductor element consisting of a conductor that is non-contact with the first antenna with respect to DC components and in contact with a ground conductor with respect to DC components and reflects the power transmitted or received by the first antenna toward the electromagnetic coupling element can be fitted with the first antenna to electromagnetically couple the electromagnetic connecting element and the ground conductor element with the first antenna, thus inhibiting unnecessary power emissions and reducing transmission

loss.

An external-antenna connecting apparatus and an onboard external-antenna connecting apparatus, wherein a portable radio terminal is positioned from above to secure it to a body and an electromagnetic coupling circuit that is non-contact with the portable radio terminal with respect to DC components is disposed in the body, and the portable radio terminal is positioned from above the body to electromagnetically couple the antenna of the portable radio terminal and an external antenna together, allow durability between a conventional electromagnetic coupling or portable radio terminal and the antenna, and the ease of operation by a user to be improved.

The nature, principle and utility of the invention will become more apparent from the following detailed description when read in conjunction with the accompanying drawings in which like parts are designated by like reference numerals or characters.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

Fig. 1 is a schematic diagram showing the general arrangement of a conventional antenna coupling apparatus;

Fig. 2 is a schematic diagram showing the general arrangement of a conventional external-antenna connecting apparatus;

Fig. 3 is a schematic diagram showing the general

arrangement of a conventional external-antenna connecting apparatus;

Fig. 4 is a schematic diagram showing the general arrangement of the antenna coupling apparatus according to the first embodiment of the present invention;

Fig. 5 is a characteristic curvilinear diagram showing the passage characteristics of the antenna coupling apparatus according to the first embodiment and a conventional antenna coupling apparatus;

Fig. 6 is a schematic diagram showing the general arrangement of the antenna coupling apparatus according to another embodiment.

Fig. 7 is a schematic diagram showing the general arrangement of the antenna coupling apparatus according to still another embodiment;

Fig. 8 is a characteristic curvilinear diagram showing changes in the connection characteristics of an antenna coupling apparatus due to the availability of a ground conductor element and a matching circuit;

Fig. 9 is a schematic diagram showing the general arrangement of the external-antenna connecting apparatus according to the second embodiment of the present invention;

Fig. 10 is a schematic diagram showing the general arrangement of the onboard external connecting apparatus

according to the third embodiment of the present invention;

Figs. 11A and 11B are schematic diagrams showing the general arrangement of the onboard external-antenna connecting apparatus in use and not in use according to the third embodiment;

Fig. 12 is a schematic diagram explaining a mechanism of the moving part of the onboard external-antenna connecting apparatus of Figs. 11A and 11B; and

Figs. 13A and 13B are schematic diagrams showing the general arrangement of the onboard external-antenna connecting apparatus according to another embodiment.

DETAILED DESCRIPTION OF THE EMBODIMENT

Preferred embodiments of the present invention will be described with reference to the accompanying drawings:

(1-1) First Embodiment

Fig. 4, in which the same reference characters designate common parts as in Fig. 1, shows the general arrangement of the antenna coupling apparatus in the first embodiment of the present invention. The antenna coupling apparatus 20 comprises an electromagnetic coupling element 2, a transmission cable 3, a ground conductor element 21, and a ground conductor 4.

The electromagnetic coupling element 2 and the ground conductor element 21 are ring-shaped. The electromagnetic coupling element 2 electromagnetically couples an external antenna (not shown) with the antenna 6, a helical antenna fitted

with a nonconducting cover, of a portable radio terminal 5. The core of the transmission cable 3 connected to the external cable is connected to the electromagnetic coupling element 2; the outer conductors of the transmission cable 3 are connected to the ground conductor 4. The ground conductor element 21, reflecting unnecessarily emitted power, is disposed on the ground conductor 4 in parallel with the electromagnetic coupling element 2, with an interval S2 in between, and is in contact with the ground conductor 4.

The ground conductor 4 is fitted with the antenna 6 on its top. This is done so that the body of the portable radio terminal 5 is arranged on the electromagnetic coupling element 2 side. The electromagnetic coupling element 2 and the ground conductor element 21 are disposed at any positions according to the size of the antenna 6, the electromagnetic coupling element 2, and the ground conductor element 21.

In the above arrangement, the antenna 6 installed on the portable radio terminal 5 is inserted into the electromagnetic coupling element 2 and the ground conductor element 21 in ring shape. When placed in the electromagnetic coupling element 2, the antenna 6 is electromagnetically coupled. Some of the power transmitted from the antenna 6 is received by the electromagnetic coupling element 2. Some of the remaining power that is not received by the electromagnetic coupling element 2, that is, some

of the power that has thus far been unnecessarily emitted is reflected by the ground conductor element 21 toward the electromagnetic coupling element 2 side and received by the electromagnetic coupling element 2. Thus unnecessarily emitted power and transmission loss are reduced, compared with conventional portable radio terminals.

Transmission-reception processes using such type of electromagnetic coupling are reversible. For transmitting the power received by the external antenna to the portable radio terminal 5, the power is transmitted from the electromagnetic coupling element 2 through the transmission cable 3 to the antenna 6. Some of the power is received by the antenna 6. Some of the remaining power that is not received by the antenna is reflected by the ground conductor element 21 toward the electromagnetic coupling element 2 side and received by the antenna 6. Thus transmission loss can be reduced as in transmission.

Fig. 5 shows the characteristics of power passage from the antenna coupling apparatus 20 of the first embodiment and a conventional antenna coupling apparatus 1 to a portable radio terminal antenna. In Fig. 5, curves a and c represent the characteristics of the conventional antenna coupling apparatus 1 (without a ground conductor element), and curve b represents the characteristics of the antenna coupling apparatus 20, having the ground conductor element 21, of the first embodiment. Curve a is

for an electromagnetic coupling element 2 having a width of 3 mm, and curve c is for an electromagnetic coupling element 2 having a width of 2.2 mm.

Fig. 5 showing that the ground conductor element 21 allows consistent characteristics to be provided over a wide frequency range proves that the element is effective. The example measurements of Fig. 5 disclose that the antenna coupling apparatus using the electromagnetic coupling element having a width of 2.2 mm (curve c in Fig. 5) exhibits a little more consistent characteristic than that using the electromagnetic coupling element 2 having a width of 3.0 mm (curve a in Fig. 5) over a wide frequency range.

In the above arrangement, disposing the ground conductor element 21, which is in contact with the ground conductor 4 with respect to DC components, in parallel with the electromagnetic coupling element 2, with the interval S2 in between, allows a consistent characteristic to be provided over a broad frequency range. Arranging the ground conductor element 21 can cause some of the power that has thus far been unnecessarily emitted to be reflected toward the electromagnetic coupling element 2 side. Thus transmission loss is reduced, compared with conventional one.

(1-2) Variation

In the first embodiment described above, a helical antenna

fitted with a nonconducting cover is used as the antenna 6 of the portable radio terminal 5, however, the present invention may use not only such a helical antenna but a monopole antenna fitted with a nonconducting cover as an antenna of the portable radio terminal or a composite antenna fitted with a nonconducting cover, which antenna consists of a helical antenna and a monopole antenna.

In the first embodiment described above, the antenna 6 of the portable radio terminal 5 and the external antenna are electromagnetically coupled together, however, the present invention may use not only such a combination but an electromagnetic coupling of the antenna of the portable radio terminal and for example, a given high-frequency circuit.

Further in the first embodiment described above, the electromagnetic coupling element 2 and the ground conductor element 21 in ring shape that are closed against loop current, however, the present invention may use not only such a ring-shaped electromagnetic coupling element and a ring-shaped ground conductor element but an electromagnetic coupling element and a ground conductor element, both of which are open at the top like a letter of the alphabet U or are of ring or U shape having a width in the X direction.

As shown in Fig. 6, for example, where the same reference characters designate common parts as in Fig. 4, a plurality of electromagnetic coupling elements 23 and a plurality of ground

conductor elements 24 may be provided. Disposing in the antenna coupling apparatus 22 the electromagnetic coupling elements 23 and the ground conductor elements 24 at any plurality of positions, taking into account the matching of the antenna 6 installed on the portable radio terminal 5, causes transmission loss due to the antenna 6 to be effectively reduced.

The transmission cable connected to the external antenna and the antenna 6 of the portable radio terminal 5 may not match each other. To solve this problem, a metal part 27 that is isolated with respect to DC components from the ground conductor 4 is provided on the ground conductor 4 on a top surface of a dielectric base 26, both sides of which are covered with metal, in an antenna coupling apparatus 25 of Fig. 7. Forming a matching circuit consisting of an electromagnetic coupling element 2, a chip element 28 (capacitor or coil), and the like on the metal part 27 causes the matching between the antenna 6 and the antenna coupling apparatus 25 to be improved.

For the above arrangement, Fig. 8 shows the characteristic of coupling between the antenna coupling apparatus and the antenna of the portable radio terminal. A letter of the alphabet a designates the characteristic curve of a conventional antenna coupling apparatus 1 (having no ground conductor element) whose matching condition is improved by forming a matching circuit, and a letter of the alphabet b indicates the characteristic curve of

an antenna connecting apparatus whose matching condition is improved by providing a ground conductor element 21 and a matching circuit as in the case of the antenna coupling apparatus 25. Curve c shows the characteristic of an antenna coupling apparatus without a ground conductor element and a ground conductor whose matching condition is improved by forming a matching circuit.

These characteristic curves show that providing an antenna coupling apparatus with a ground conductor reduces transmission loss. It also shows that installing a ground conductor element in an antenna coupling apparatus having a matching circuit reduces transmission loss over a wider frequency range. Because the matching condition of the antenna coupling apparatus can be improved in these ways, that of the portable radio terminal antenna can be prevented from deteriorating.

(2) Second Embodiment

Fig. 9 shows the general arrangement of the external-antenna connecting apparatus of the second embodiment. The external-antenna connecting apparatus 30 comprises a case 31, an electromagnetic coupling circuit 32, and a transmission cable 33. The electromagnetic coupling circuit 32 corresponds to a U-shaped electromagnetic coupling element 2 and a U-shaped ground conductor element 21 of the antenna coupling apparatus 20.

The case 31 for the external-antenna connecting apparatus 30

is shaped to cover the upper part of the portable radio terminal 5, which part includes the antenna 6 installed to the terminal, and hold the entire portable radio terminal 5 when fitted over the terminal 5 to the case 31.

The electromagnetic coupling circuit 32 fitted with a nonconducting cover is disposed over the region of the case 31 where the antenna 6 is placed. The electromagnetic coupling apparatus 32 has a U-shaped cross section corresponding to the dimensions of the antenna 6, a helical antenna fitted with a nonconducting cover.

The transmission cable 33 is connected to the case 31, which cable 33 is adapted to transmit power from the external antenna through the electromagnetic coupling circuit 32 to the antenna 6.

In the above arrangement, the portable radio terminal 5 is positioned on the top surface of the case 31 for the external-antenna connecting apparatus 30. The upper part of the portable radio terminal 5 including the antenna 6 is directly placed on the case 31 and the entire portable radio terminal is held.

The antenna 6, when positioned over the electromagnetic coupling circuit 32 disposed on the case 31, is electromagnetically coupled with the circuit. The electromagnetic coupling circuit 32 receives the power transmitted by the antenna 6 and sends the power through the transmission cable 33 to the external antenna. For transmitting

the power received from the external antenna to the portable radio terminal 5, the power received from the external antenna is fed from the electromagnetic coupling circuit 32 through the transmission cable 33 to the antenna 6.

In the above arrangement, the electromagnetic coupling circuit 32 fitted with the nonconducting cover is disposed over the region of the case 31, shaped so that the upper part of the portable radio terminal 5 including the antenna 6 can be placed thereon, in which region the antenna 6 is placed, and the case 31 is provided with the transmission cable 33 connected to the electromagnetic coupling circuit 32. Thus the body of the portable radio terminal 5 and the antenna coupling apparatus 30 are secured by the body of the portable radio terminal 5 and the case 31, so that a stable electromagnetic coupling can be made without overloading the antenna 6.

Unlike conventional portable radio terminals, the portable radio terminal 5 does not need to be provided therein with a cable and a switch which connect an antenna power supply with a connector, since power is exchanged between the electromagnetic coupling circuit 32 and the antenna 6. This allows the portable radio terminal 5 to be upgraded and reduced in size and its cost to be lowered.

In the second embodiment described above, a helical antenna fitted with a nonconducting cover is used as the antenna 6 of the portable radio terminal 5, however, the present invention may use

not only such a helical antenna but a monopole antenna fitted with a nonconducting cover or a composite antenna fitted with a nonconducting cover, which antenna consists of a helical antenna and a monopole antenna.

Also in the second embodiment described above, the electromagnetic coupling circuit 32 is fitted with the nonconducting cover, however, the present invention may use not only such an electromagnetic coupling circuit 32 but an exposed one.

Again in the second embodiment described above, the case 31 that is shaped so that the upper part of the portable radio terminal 5 including the antenna 6 of the portable radio terminal 5 can be positioned on the case, however, the present invention may use not only such a case but one that is shaped to bear a part of the portable radio terminal 5 including the antenna 6 and stably hold the body of the terminal 5.

(3-1) Third Embodiment

Fig. 10 shows the general arrangement of the onboard external-antenna connecting apparatus of the third embodiment.

The onboard external-antenna connecting apparatus 40, an onboard unit having the external-antenna connecting apparatus 30 of the second embodiment, comprises a case 41, an electromagnetic coupling circuit 42, an external power supply cable 43, an RF

cable 44, an external power supply connector 45, and a connector cable 46.

The case 41 for the onboard external-antenna connecting apparatus 40 is recessed according to the shape of the portable radio terminal 5 to place and secure the entire portable radio terminal 5 including the antenna 6.

The U-shaped electromagnetic coupling circuit 42 fitted with a nonconducting cover is disposed over the region of the case 41 where the antenna 6 is positioned. The electromagnetic coupling circuit 42 has a U-shaped cross section corresponding to the dimensions of the antenna 6, a helical antenna fitted with a nonconducting cover.

The case 41 is provided with the external power supply cable 43, the RF cable 44, and connector cable 46 having the external power supply connector 45 at one of its ends. The RF cable 44 is connected to the electromagnetic coupling circuit 42, through which cable electromagnetic coupling is relied on to exchange power between an external antenna and the antenna 6. The external power supply cable 43 is connected to an automobile power supply or the like, and the external power supply connector 45 at one end of the connector cable 46 is connected with the connector terminal 14 of the portable radio terminal 5 to charge the battery of the terminal 5 using an automobile power supply or the like.

Figs. 11A and 11B, in which the same reference characters

designate common parts as in Fig. 10, shows an onboard external-antenna connecting apparatus 50, in whose case a connector is disposed. The onboard external-antenna connecting apparatus 50 comprises a case 51, an electromagnetic coupling circuit 42, an external power supply cable 43, and an RF cable 44. The case 51 for the onboard external-antenna connecting apparatus 50 has the electromagnetic coupling circuit 42 at one of its ends and a moving part 52 at the other end.

As shown in Fig. 12, the moving part 52 is disposed at a predetermined angle to the side of the case 51. The moving part 52, a rectangular plate on which an external power supply connector terminal 53 is disposed, which part has its upper side secured to the upper edge of a side of the case 51, can be moved by a spring between itself and the side of the case. The external power supply connector terminal 53 is adapted to be connected with the connector of the portable radio terminal 5 by positioning the terminal 5 on the case 51.

As shown in Fig. 11A, in the above arrangement, the moving part 52 of the onboard external-antenna connecting apparatus 50 is slanted at a predetermined angle when the portable radio terminal 5 is not installed in the apparatus.

When the portable radio terminal 5 is installed in the onboard external-antenna connecting apparatus 50, pushing in the body of the portable radio terminal 5 with the connector side of

the terminal 5 in contact with the moving part 52 causes the moving part 52 to cooperate with the terminal and thus the rectangular plate comes to a position parallel with the side of the case 51. As a result, the portable radio terminal 5 is stably secured to the onboard external-antenna connecting apparatus 50, so that the apparatus can easily be connected with the connector terminal of the portable radio terminal 5.

When the portable radio terminal 5 is in the onboard external-antenna connecting apparatus 50, connecting the external power supply cable 43 with an automobile power supply and so on allows the battery of the terminal 5 to be charged. The RF cable 44 is connected to an external antenna to transmit the power from the external antenna through the RF cable 44 to the antenna 6 of the portable radio terminal 5, using electromagnetic coupling due to the electromagnetic coupling circuit 42. Electromagnetic coupling causes the power from the antenna 6 of the portable radio terminal 5 to be transmitted through the RF cable 44 to the external antenna.

Unlike conventional onboard external-antenna connecting apparatuses, the onboard external connecting apparatus 40 arranged as described above does not need to be provided in the portable radio terminal 5 with a cable and a switch which connect an antenna power supply with a connector, since power is exchanged between the electromagnetic coupling circuit 42 and the antenna 6. This allows the portable radio terminal 5 to be

improved for performance and reduced in size.

For the onboard external-antenna connecting apparatus 40, connecting the external power supply connector 45 with the connector terminal 14 of the portable radio terminal 5 and connecting the external power supply cable 43 with an automobile power supply through the connector cable 46 allows the battery of the terminal 5 to be charged and a call to be made using the automobile power supply. That is, the onboard external-antenna connecting apparatus 40 has a structure suitable for arranging a handsfree unit that allows a call to be made inside an automobile without holding the portable radio terminal 5 in hand.

The onboard external-antenna connecting apparatus 50, having the moving part 52 inside the case 51, allows not only electromagnetic coupling to be made without overloading the antenna 6 of the portable radio terminal but the battery of the terminal 5 to be charged and a call to be made using an automobile power supply. In addition, the onboard external-antenna connecting apparatus enables the portable radio terminal 5 to be improved for performance and reduced in size.

(3-2) Variation

In the third embodiment described above, the case 51 is provided with the moving part 52, on which the external power supply connector 53 is installed, however, the present invention may use a case where an external power supply connector terminal

is directly installed.

Figs. 13A and 13B, in which the same reference characters designate common parts as in Figs. 11A and 11B, show the general arrangement of a variation of the onboard external-antenna connecting apparatus. An onboard external-antenna connecting apparatus 60 comprises a case 61, an electromagnetic coupling circuit 42, an external power supply connector terminal 62, an external power supply cable 43, and an RF cable 44.

The external power supply connector terminal 62 consisting of a plurality of metal pieces is disposed in the case 61. The external power supply connector terminal 62 is a connector protruded from a surface of the case, which connector is installed along a side of the bottom of the case 61, in which the bottom of the portable radio terminal 5 is placed. A recessed connector terminal 63 (for example, a female connector) matching the metal pieces constituting the external power supply connector terminal 62 is disposed in the lower part of the back of the body of the portable radio terminal 5.

Housing the portable radio terminal 5 in the onboard external-antenna connecting apparatus 60 to connect the external power supply connector terminal 62 with the connector terminal 63 causes the apparatus 60 and the terminal 5 to electrically come in contact with each other and thus the terminal 5 to be connected with an external power supply or the like. The onboard external-antenna connecting apparatus 60 allows not only

electromagnetic coupling to be made without overloading the antenna 6 of the portable radio terminal 5 but the battery of the terminal 5 to be charged and a call to be made using an automobile power supply. In addition, the onboard external-antenna connecting apparatus 60 enables the portable radio terminal 5 to be improved for performance and reduced in size.

As described above, according to the present invention, an antenna coupling apparatus is provided with an electromagnetic coupling element comprising a conductor that is non-contact with a first antenna with respect to DC components and electromagnetically couples the first antenna and a second antenna together and with a ground conductor element comprising a conductor that is non-contact with the first antenna with respect to DC components and in contact with a ground conductor with respect to DC components and reflects the power transmitted or received by the first antenna toward the electromagnetic coupling element in order to inhibit unnecessary power emissions and reduce transmission loss.

Furthermore, according to the present invention, a portable radio terminal is positioned from above to secure it to a body, and an electromagnetic coupling circuit that electromagnetically couples the antenna of the portable radio terminal and an external antenna together, being non-contact with the portable radio terminal with respect to DC components, when the portable

radio terminal is positioned in the body is disposed inside the body to provide an external-antenna connecting apparatus and an onboard external-antenna connecting apparatus which allow durability between a conventional electromagnetic coupling or portable radio terminal and the antenna, and the ease of operation by a user to be improved.

While there has been described in connection with the preferred embodiments of the invention, it will be obvious to those skilled in the art that various changes and modifications may be aimed, therefore, to cover in the appended claims all such changes and modifications as fall within the true spirit and scope of the invention.

WHAT IS CLAIMED IS:

1. An antenna coupling apparatus comprising:

a first antenna installed to a portable radio terminal;

a second antenna differing from said first antenna together;

an electromagnetic coupling element consisting of a conductor that is electromagnetically couples said first and said second antennas together; and

a ground conductor element for reflecting the power transmitted or received by said first antenna toward said electromagnetic coupling element.

2. The antenna coupling apparatus according to claim 1, wherein said electromagnetic coupling element and said ground conductor element are open at the top like a letter of the alphabet U, or are of ring or U shape having a width in the X direction.

3. The antenna coupling apparatus according to claim 1, wherein said first antenna and said second antenna are electromagnetically coupled together, using a plurality of said electromagnetic coupling elements and/or said ground conductor elements.

4. The antenna coupling apparatus according to claim 1, comprising a matching circuit that matches said first antenna with said second antenna.

5. The antenna coupling apparatus according to claim 1, wherein said electromagnetic coupling elements and said ground conductor elements are disposed at any plurality of positions, taken into

account the matching of said first antenna.

6. The antenna coupling apparatus according to claim 1, wherein a composite antenna consisting of a helical antenna and a monopole antenna is used as said first antenna.

7. An external-antenna connecting apparatus comprising:

an antenna installed to a portable radio terminal;

an external antenna coupled with said antenna;

a body for securing said portable radio terminal to said body;

an electromagnetic coupling circuit disposed in said body, which circuit electromagnetically couples the antenna of said portable radio terminal and said external antenna together, being non-contact with said portable radio terminal with respect to DC components, when said portable radio terminal is secured to said body.

8. The external-antenna connecting apparatus according to claim 7, wherein said electromagnetic coupling circuit is fitted with a nonconducting cover.

9. The external-antenna connecting apparatus according to claim 7, wherein said electromagnetic coupling circuit has a U-shaped cross section corresponding to an electromagnetic coupling element and a ground conductor element.

10. The external-antenna connecting apparatus according to claim 7, said antenna connecting apparatus has a case for said portable

radio terminal, and is shaped to cover the part which includes the antenna of said portable radio terminal, and hold the entire portable radio terminal when fitted over the terminal to the case.

11. An onboard external-antenna connecting apparatus comprising:

an antenna installed to a portable radio terminal;

an external antenna connected to said antenna;

an external power for supplying power to said portable radio terminal;

a body for securing said portable radio terminal to said body by positioning from above;

an electromagnetic coupling circuit disposed in said body, which circuit electromagnetically couples the antenna of said portable radio terminal and said external antenna together, being non-contact with said portable radio terminal with respect to DC components, when said portable radio terminal is positioned in said body from above; and

a connecting member for connecting said external power supply and said portable radio terminal together to supply power from said external power supply to said portable radio terminal.

12. The onboard external-antenna connecting apparatus according to claim 11, wherein:

a moving part operating in conjunction with the positioning of said portable radio terminal when said portable radio terminal is housed is disposed in said body, a first connector for feeding

power from said external power supply to said portable radio terminal is installed on said moving part; and

a second connector for feeding power from said external power supply when connected with said first connector is installed on said portable radio terminal.

13. The onboard external-antenna connecting apparatus according to claim 11, wherein said moving part is disposed at a predetermined angle to the side of the case, and can be moved by a spring between itself and the side of the case, so that said portable radio terminal is stably secured when installed in the onboard external-antenna connecting apparatus.

14. The onboard external-antenna connecting apparatus according to claim 11, wherein:

first metal pieces for feeding power from said external power supply to said portable radio terminal when said portable radio terminal is housed, are disposed in said body; and

second metal pieces for feeding power from said external power supply when connected with said first metal pieces are disposed in said portable radio terminal.

15. The onboard external-antenna connecting apparatus according to claim 11, wherein:

said first metal pieces and said second metal pieces, either one is protruded connectors and the other is recessed connectors matching with each other.

ABSTRACT OF THE DISCLOSURE

An antenna coupling apparatus, an external-antenna connecting apparatus, and an onboard external-antenna connecting apparatus which inhibits unnecessary power emissions, reduces transmission loss, and offers high durability and high ease of operation. An antenna coupling apparatus has an electromagnetic coupling element consisting of a conductor that is non-contact with a first antenna with respect to DC components and a ground conductor element consisting of a conductor that is non-contact with the first antenna with respect to DC components and in contact with a ground conductor with respect to DC components and reflecting the power transmitted or received by the first antenna toward the electromagnetic coupling element. An external-antenna connecting apparatus and an onboard external-antenna connecting apparatus have an electromagnetic coupling circuit in their bodies that electromagnetically couples the antenna of a portable radio terminal and an external antenna, with the external-antenna connecting apparatus and the onboard external-antenna connecting apparatus, being non-contact with the portable radio terminal with respect to DC components, when the portable radio terminal is secured in the bodies.

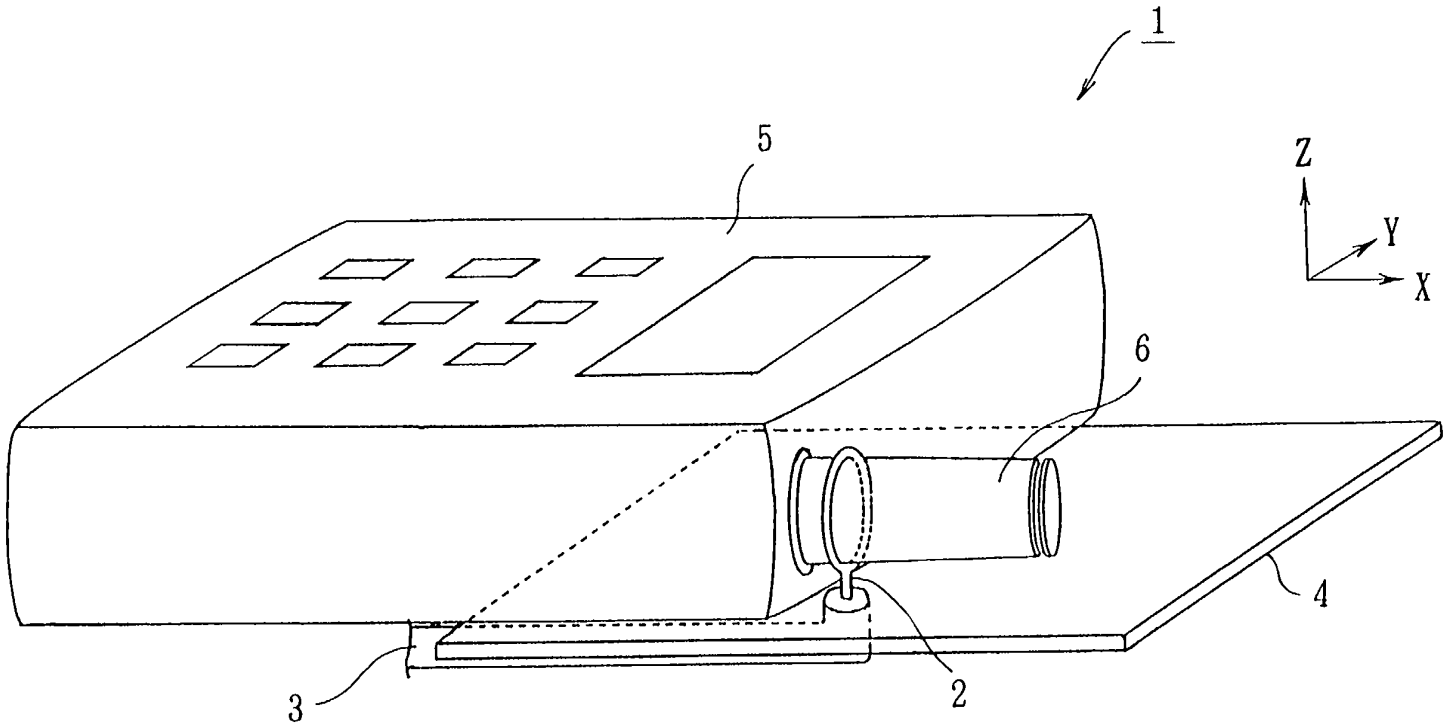


FIG. 1 (RELATED ART)

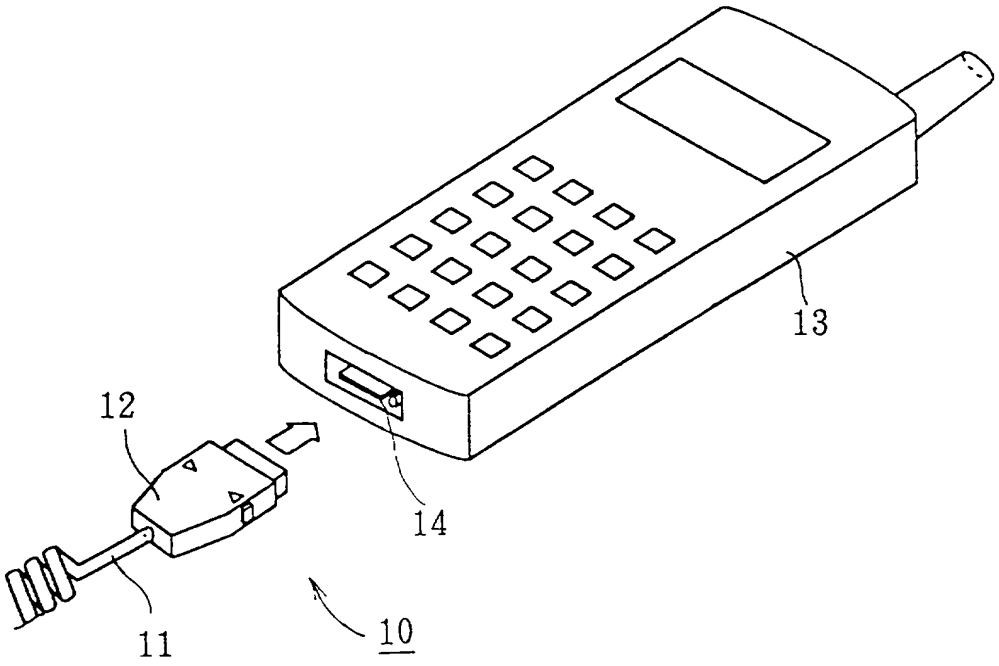


FIG. 2 (RELATED ART)

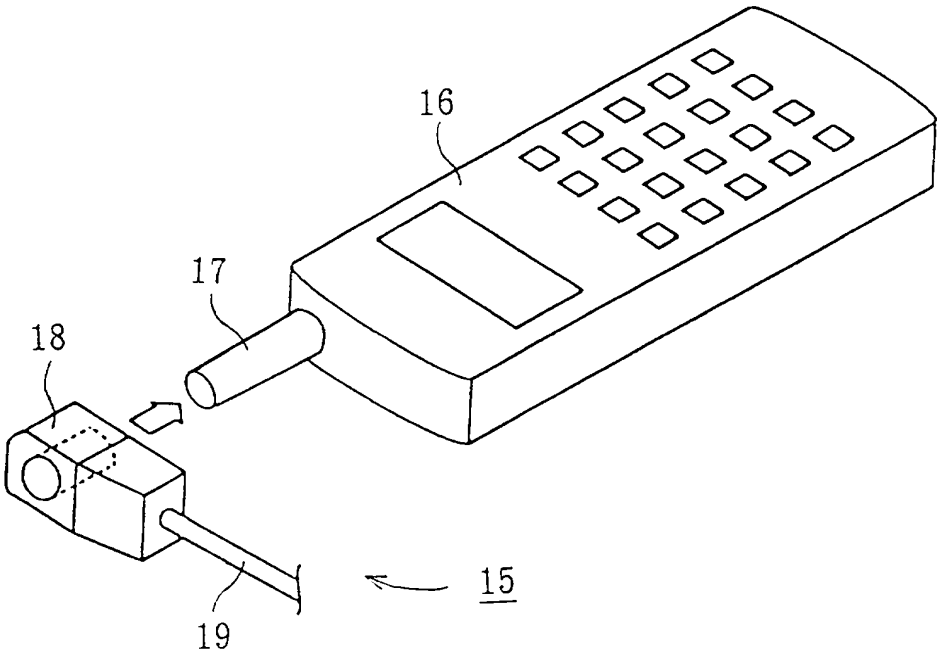


FIG. 3 (RELATED ART)

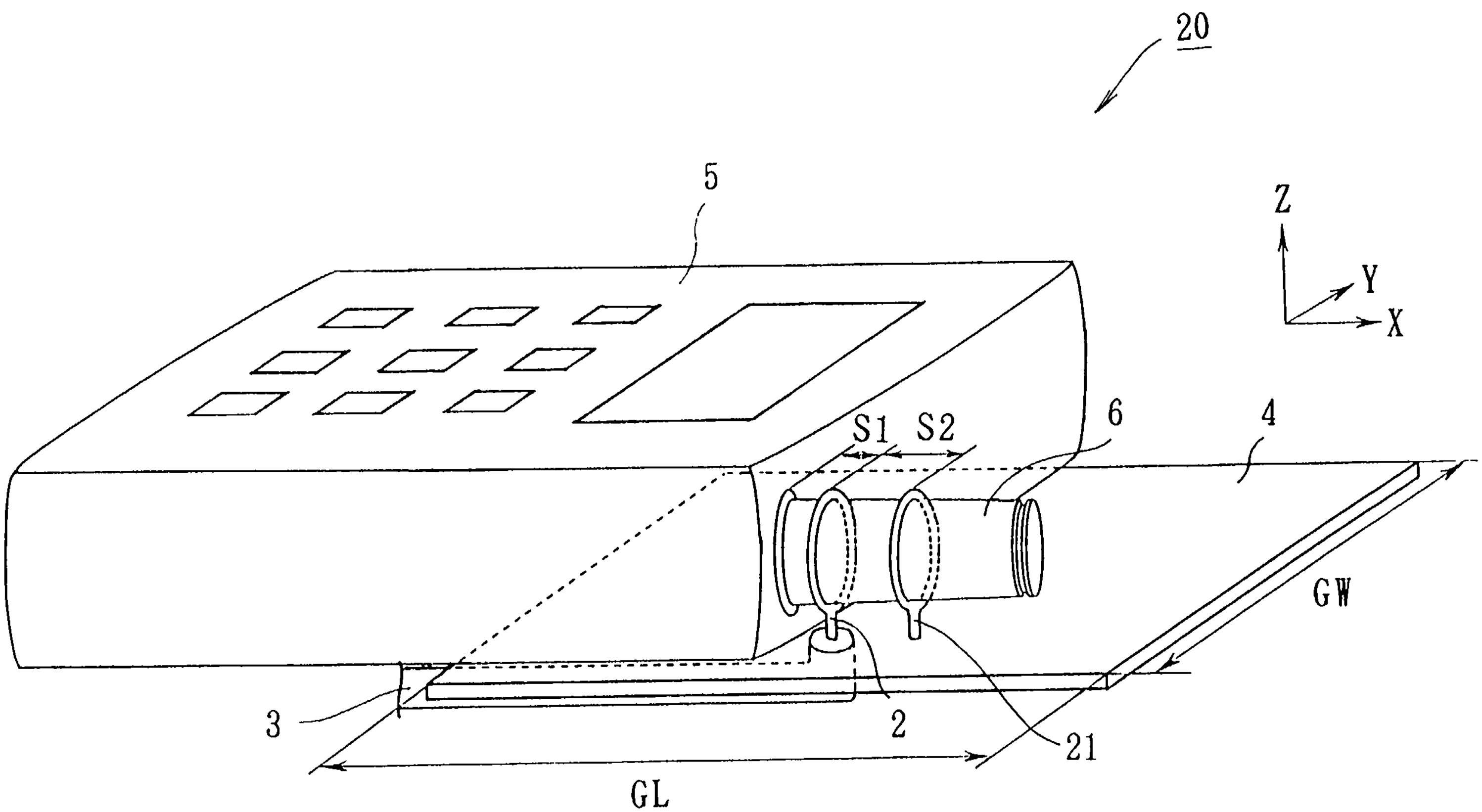
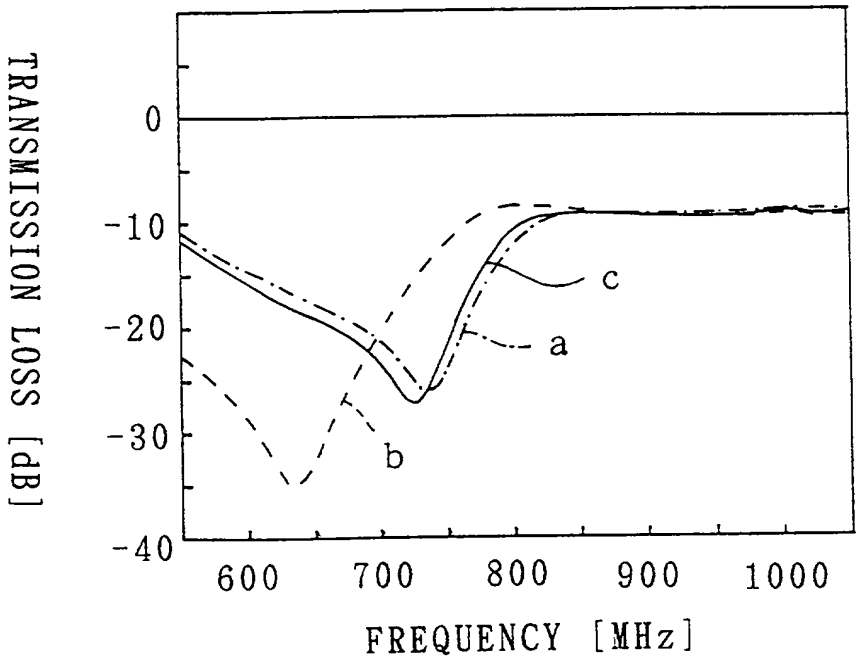


FIG. 4


TRANSMISSION LOSS [dB]
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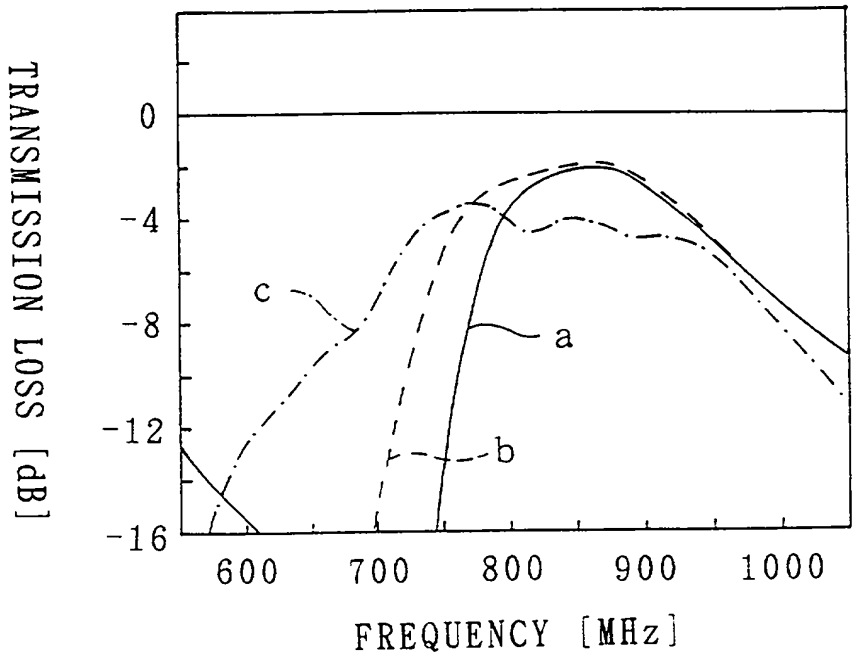
-20
-30
-40
600
700
800
900
1000
FREQUENCY [MHz]
a
b
c

FIG. 5


TRANSMISSION LOSS [dB]
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600
700
800
900
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FREQUENCY [MHz]
a
b
c

FIG. 8

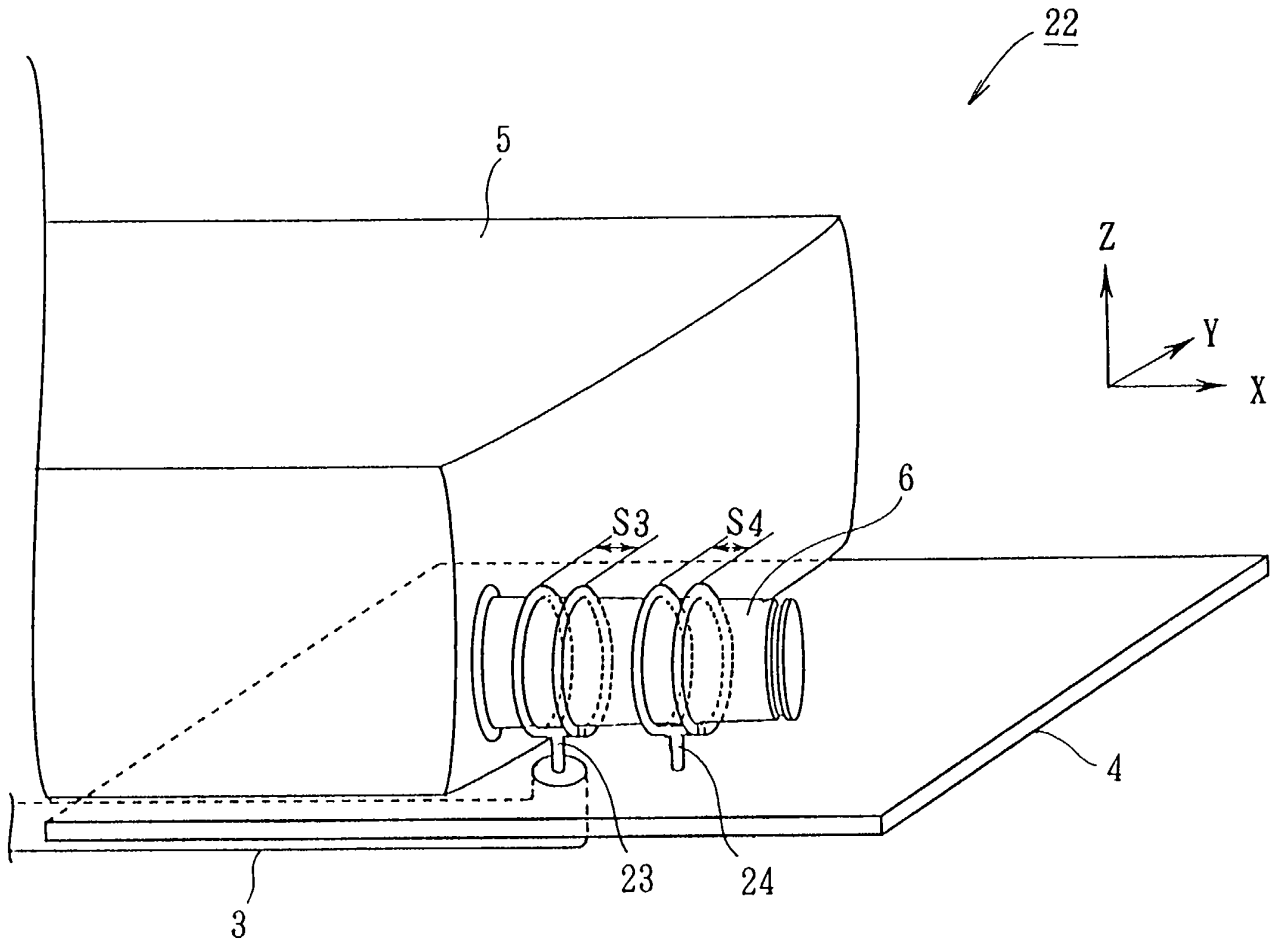


FIG. 6

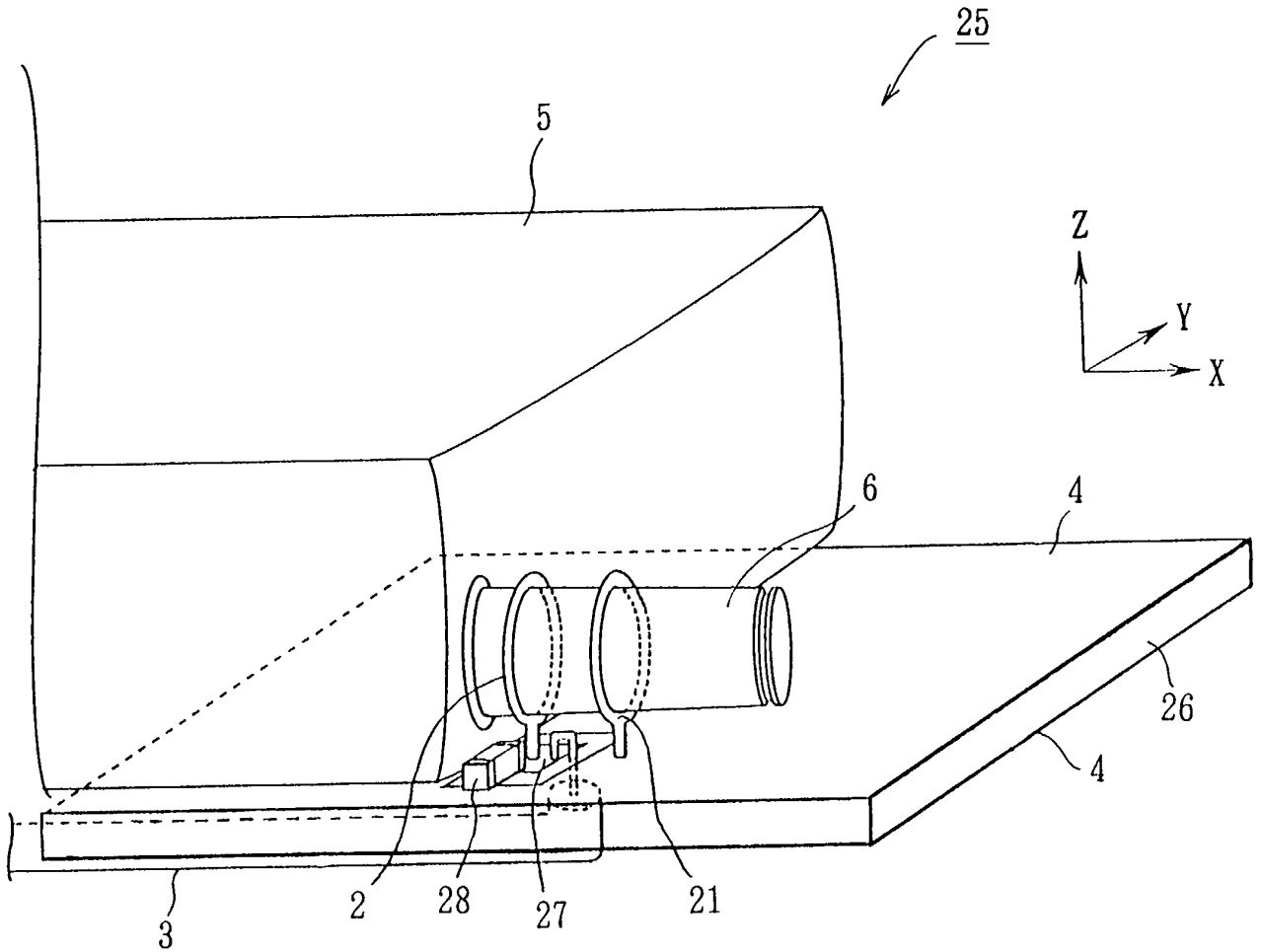


FIG. 7

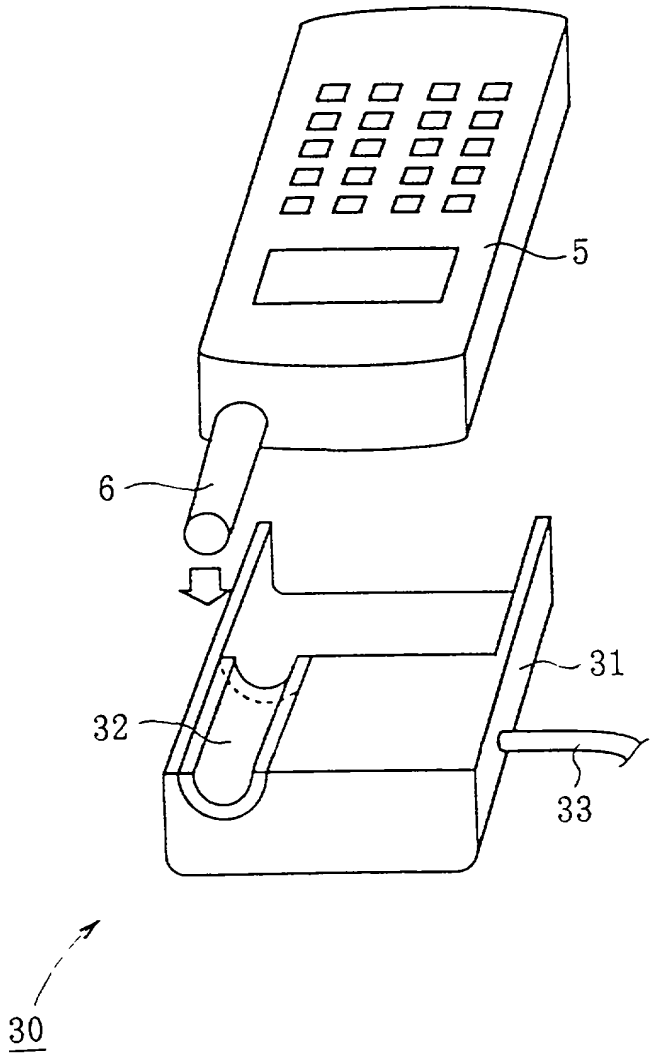


FIG. 9

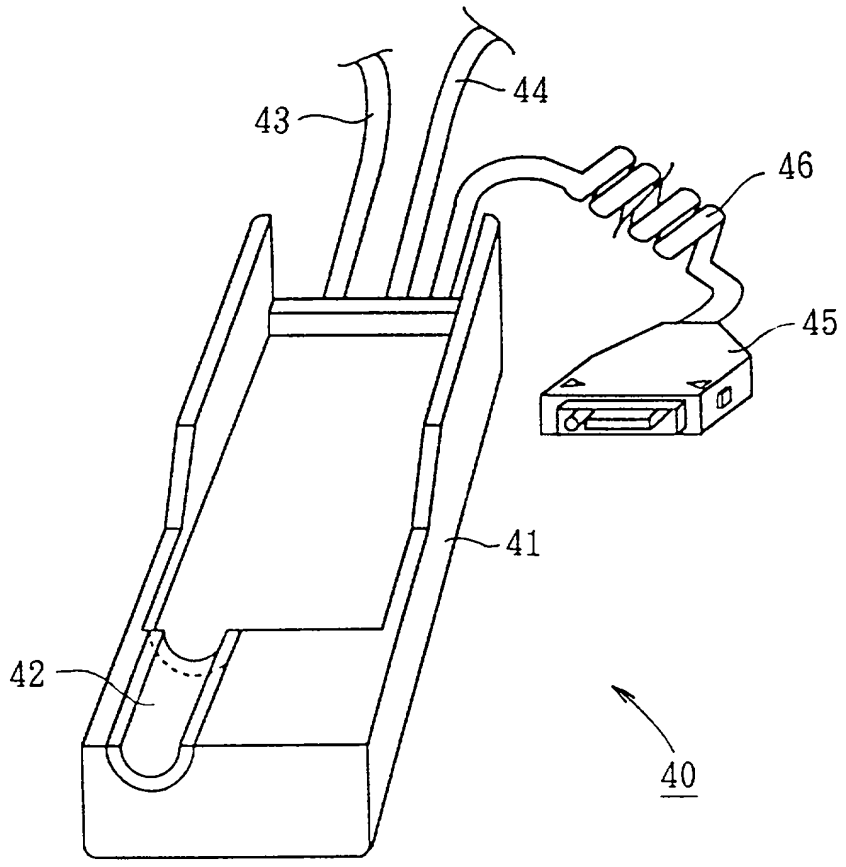


FIG. 10

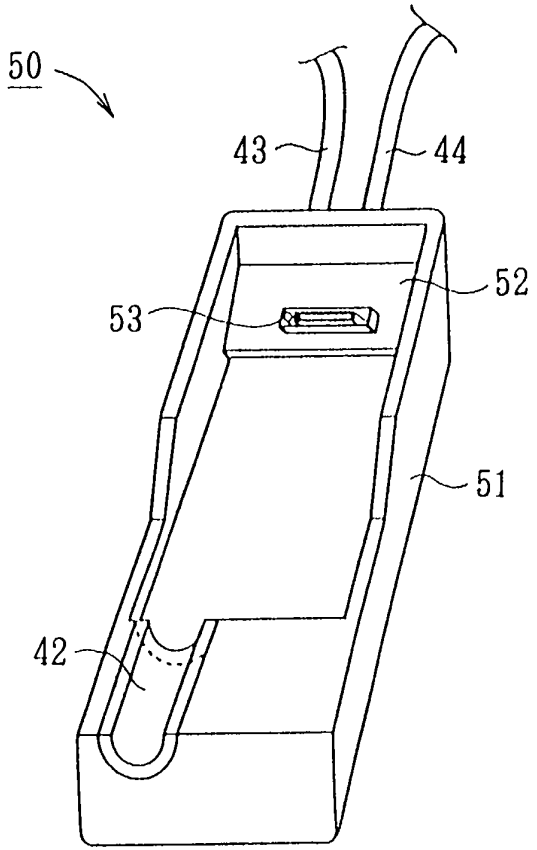


FIG. 11A

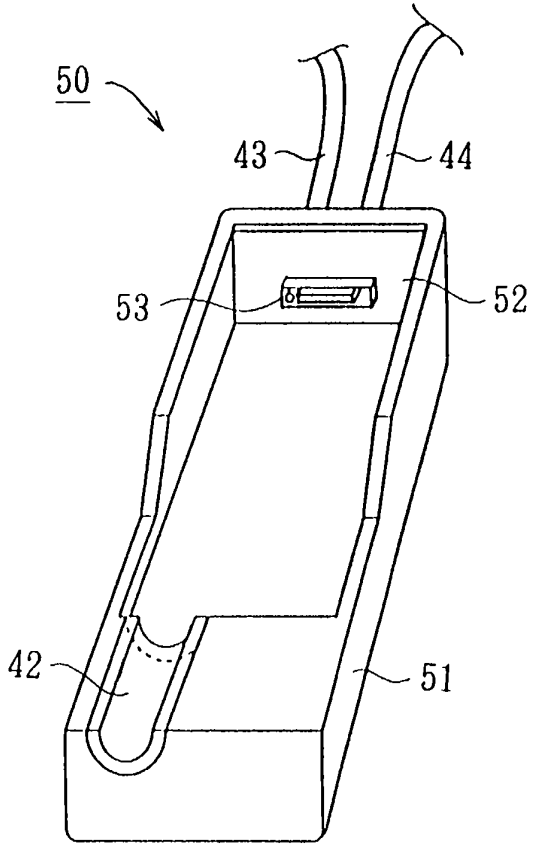


FIG. 11B

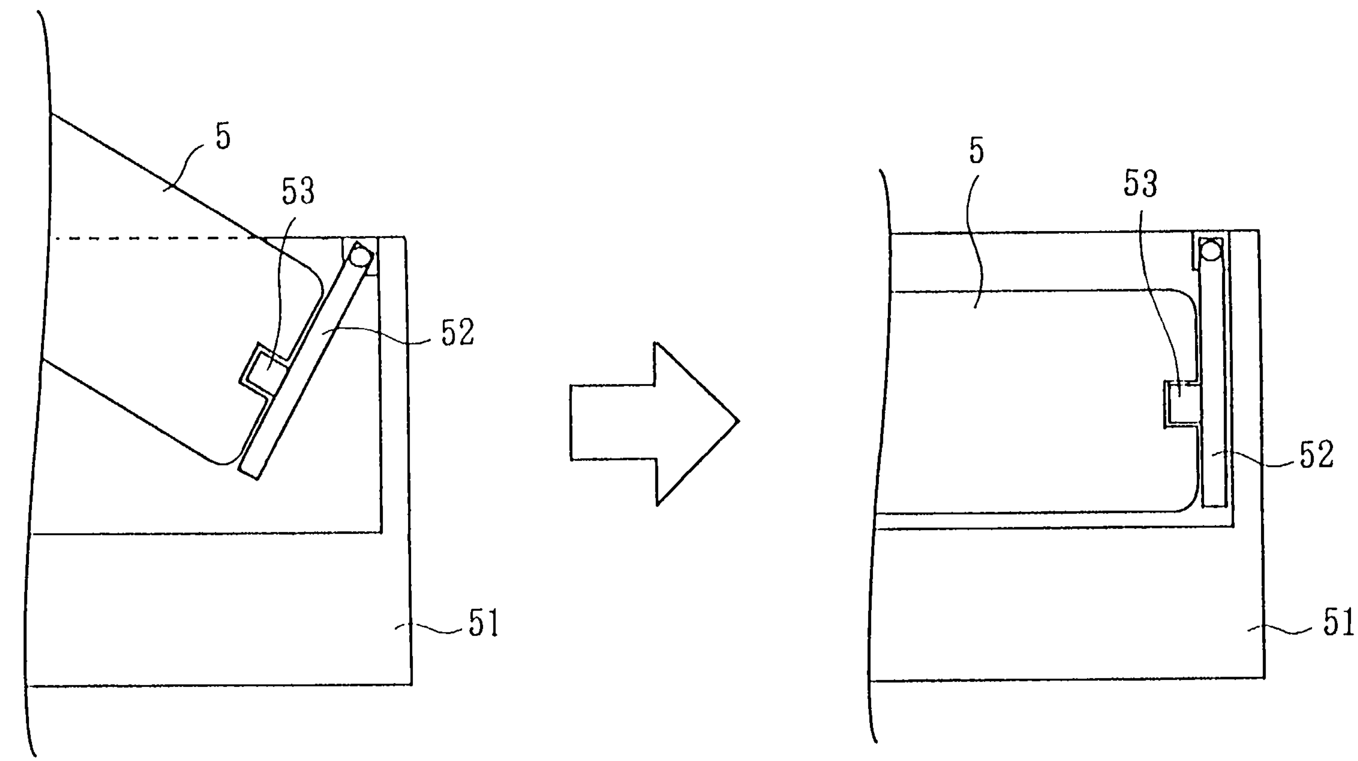


FIG. 12

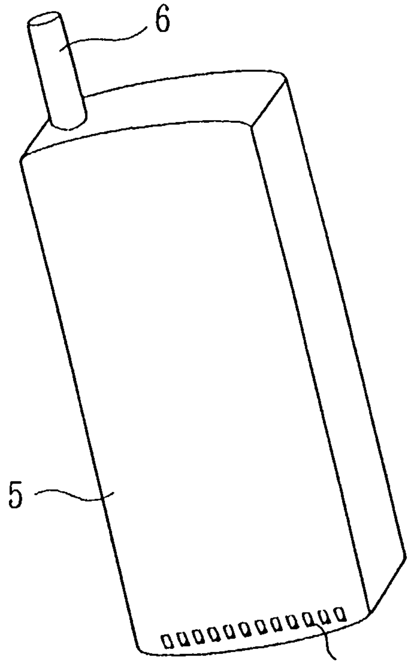


FIG. 13A

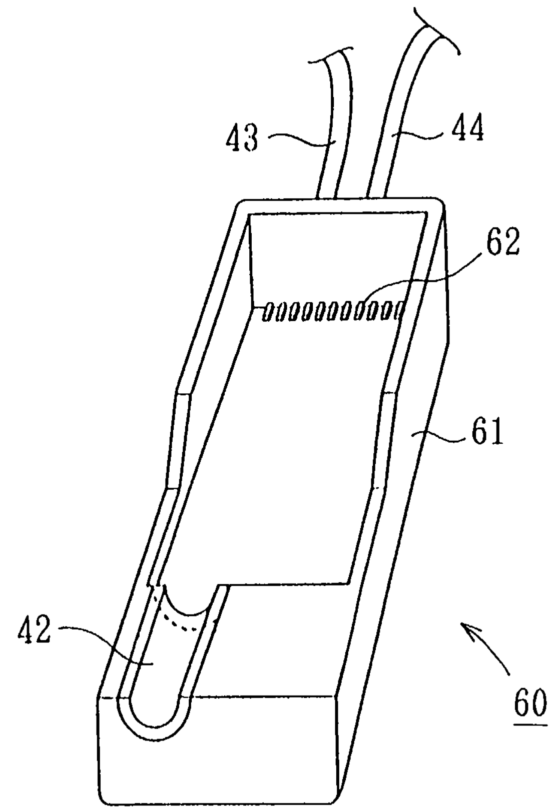


FIG. 13B

Docket Number 7217/50539

DECLARATION AND POWER OF ATTORNEY

As a below-named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

ANTENNA COUPLING APPARATUS, EXTERNAL-ANTENNA CONNECTING APPARATUS, AND ONBOARD EXTERNAL-ANTENNA CONNECTING APPARATUS

the specification of which
(check one)

_____ is attached hereto.

__x__ was filed on April 4, 1996 as

Application Serial No. 08/627,580

and was amended on _____
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information of which I am aware which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

Number	Country	Filing Date	Priority Claimed Yes	No
P07-108216	JAPAN	APRIL 8, 1995	X	

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States Application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, Section 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

Application Serial No.	Filing Date	Status

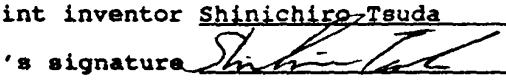
And I hereby appoint Jay H. Maioli, Reg. No. 27,213; Donald S. Dowden, Reg. No. 20,701; William E. Pelton, Reg. No. 25,702; Peter J. Phillips, Reg. No. 29,691; Gerald W. Griffin, Reg. No. 18,886; Ivan S. Kavrukov, Reg. No. 25,161; Christopher C. Dunham, Reg. No. 22,031; Norman H. Zivin, Reg. No. 25,385; John P. White, Reg. No. 28,678; Thomas G. Carulli, Reg. No. 30,616 and Robert D. Katz, Reg. No. 30,141; and each and all of them, all c/o Cooper & Dunham LLP, 1185 Avenue of the Americas, New York, NY 10036 (Tel. (212) 278-0400), my attorneys, each with full power of substitution and revocation, to receive the patent, to transact all business in the Patent and Trademark Office connected therewith and to file any International Applications which are based thereon under the provisions of the Patent Cooperation Treaty.

Please address all communications, and direct all telephone calls, regarding this application to

Jay H. Maioli Reg. No. 27,213
Cooper & Dunham LLP
1185 Avenue of the Americas
New York, New York 10036
Tel. (212) 278-0400

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or
first joint inventor Shinichiro Tsuda

Inventor's signature 

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Inventor's signature Yoshiki ~~Kanaya~~ Hanayama
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Full name of
fourth joint inventor Shinichi Kuroda

Inventor's signature Shinichi Kuroda

Citizenship Japanese Date of Signature August 9, 1996

Residence Saitama, Japan

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